NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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PROJECT APOLLO, PRE-CONTRACTURAL DOCUMENTATION AND ORBITAL RENDEZVOUS: A LITERATURE SURVEY

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ABSTRACT

In this partially annotated bibliography is covered a review of literature on Project Apollo and Orbital Rendezvous, in two parts, from August 1959 to December 4, 1961.

The references are listed alphabetically by corporate author and periodical title in one alphabet. Following the bibliography are both author and subject indexes.

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INTRODUCTION

Project Apollo was first described by name to Industry at the NASA-Industry program plans conference held on July 28-29, 1960, in Washington (see bibliographical citation number 42).

What actually became Project Apollo, with emphasized Federal financial backing and defined as a national scientific prime objective or goal began with the speech by President J. F. Kennedy to Congress on May 25, 1961. Stated simply, the program calls for landing a man on the moon. This speech was published in the New York Times on May 26, 1961, page 12, entitled "Transcript of Kennedy Address to Congress on U. S. Role in Struggle for Freedom."

Finally, after intensive competitive bidding the award of the first prime contract for the command and service module to North American Aviation, Space and Information Systems Division was announced.

In general, the material on Apollo tends to be popular or news announcements since it is all pre-contractual in nature. North American Aviation documents have not been included.

The employment of orbital rendezvous as a technique is a fairly new consideration and the material has been included since the Golovin Committee decision that it probably will be used on the Apollo Project missions.

This bibliography is divided into two parts - Part I, Project Apollo and Part II, Orbital Rendezvous. Items are listed alphabetically by periodical title and corporate author in one alphabet for each part. Please request material from Technical Information Center (TIC) on the usual "Request for Data" form. Armed Services Technical Information Agency (ASTIA) AD document numbers have been given when available to facilitate ordering from TIC. All documents have unclassified titles.

APOLLO'S MISSIONS, REQUIREMENTS, OBJECTIVES, AND SCHEDULES

(Abstracted from SPACE BUSINESS DAILY, 31 August 1961, bibliographical citation number 53).

SIX MONTHS FEASIBILITY STUDY OBJECTIVES

1. Define a manned spacecraft system meeting mission requirements.
2. Formulate program plan for implementation.
3. Identify areas requiring longlead time R & D effort.
4. Analyze cost of providing the system.

STUDY CONTRACT TIMETABLE

August 30, 1960...Industry Familiarization at the conference conducted by the Goddard Space Flight Center at the Departmental Auditorium, Constitution Avenue, N. W.
August 31 to September 6, 1960...Expression of interest to NASA.
September 7, 1960...Invitation to bidder's conference.
September 12, 1960...Bidder's conference at Space Task Group, Langley Research Center.
October 10, 1960...Proposals received.
November 14, 1960...Contracts awarded.
May 15, 1961...Contracts complete.

STUDY IMPLEMENTATION PLAN

1. Fixed fee contract
2. Prime contractors only
3. Several concurrent contracts
4. Contractors selected on basis of:
   a. Approach
   b. Technical qualifications
5. NASA liaison

EARTH ORBITAL MISSIONS

1. Lunar vehicle development flights
   a. System evaluation
   b. Crew evaluation and training
   c. Development of operational procedures

EARTH ORBITAL MISSIONS (CONT'D)

2. Space capability development flights
   a. Rendezvous
   b. Assembly in orbit
   c. Refueling
   d. Orbital maneuvers

RETURN, RE-ENTRY, AND LANDING CONDITIONS

1. Capable of safe recovery from aborts
2. Capable of ground and water landing (also capable of avoiding local hazards)
3. Designed for 72-hour post-landing survival period
4. Capable of small area landing
5. Onboard propulsion required for maneuver in space

LANDING CONSIDERATIONS

1. Parachute system
   a. Reliable large parachutes
   b. Translation capability
   c. Impact attenuation
2. Gliders
   a. Amphibious landing gear
   b. L/D and wing loading satisfactory for approach and landing maneuver
3. Emergency and post landing considerations
   a. Ground landing-heated surfaces
   b. Water landing floatation and water stability
   c. Location and survival time

AERODYNAMIC CONSIDERATIONS

1. Heating and loads
   a. Bow shock radiation
   b. Thermal and structural design criteria
2. Aerodynamic maneuvers
   a. Trade-off between L/D, guidance and maneuvering rocket capabilities
   b. Post blackout maneuvering requirements
3. Configuration
   a. Compromise between above and other guideline requirements
   b. Weight considerations

CREW AND ENVIRONMENT GUIDELINES

1. Designed for "shirt sleeve" environment
2. Designed for three-man crew
3. Provisions for radiation protection

PHYSICAL ENVIRONMENT FOR CREW

1. Atmospheric control
2. Decompression protection
3. Acceleration protection
4. Noise and vibration
5. Nutrition
6. Waste disposal
7. Interior arrangement and displays
8. Zero gravity
9. Bioinstrumentation

ATMOSPHERIC CONTROL REQUIREMENTS

1. Breathing oxygen and pressurization
2. Carbon dioxide removal
3. Cabin leakage and repair
4. Humidity and temperature control
5. Control of toxic gases
6. System instrumentation

TRACKING REQUIREMENTS

1. Trajectory data (Orbital mission: once per orbit)(Lunar mission: near continuous)
2. Navigation fix (Orbital mission: pre-retrograde)(Lunar mission: mid-course)
3. Guidance loop (Orbital and lunar mission: re-entry)

COMMUNICATIONS REQUIREMENTS

1. Voice, CW, other (Orbital mission: near continuous)(Lunar mission: near continuous)
2. Telemetry (Orbital mission: complete as required)(Lunar mission: back-up data)
3. Television (Orbital mission: no requirement)(Lunar mission: possible)

PART I - PROJECT APOLLO

1. AEROPLANE.:746, 29 June 1961.
THE APOLLO PROJECT.

2. AIRCRAFT AND MISSILES.:40-41, June 1961.
NEW FACE FOR MAN-IN-SPACE.

3. AIR FORCE. 44:43-46, August 1961.
FLIGHT LINE FOR THE FUTURE. J. S. Butz.

4. AIR FORCE TIMES. 21:32, 26 November 1960.
CONVAIR, AVCO TO TEAM IN MANNED SPACECRAFT STUDY.

5. AMERICAN ASTRONAUTICAL SOCIETY, 7TH ANNUAL MEETING.
PREPRINT 61-32.
COSTING METHODOLOGY AND THE PROGRAM COSTS FOR A MANNED LUNAR LANDING AND RETURN MISSION - PROJECT MALLAR.
T. E. Dolan, et al. Dallas, Texas: January 1961, 35 pages.

Representative picture of the costs of a proposed system is as important to the decision making process as the technical feasibility of the system. Emphasis is placed on cost analysis in the conceptual or pre-proposal phases.

6. ASTRONAUTICS. 5:141-142, November 1960.
APOLLO FORMULATED. Abe Silverstein.

7. ASTRONAUTICS. 6:20-23, July 1961.
ENTRANCE - THE U. S. LUNAR PROGRAM. Henry Simmons.

NASA's lunar program is presented with a description of the Apollo launch vehicle mission and Saturn C-1 booster.

8. AVIATION WEEK. 73:34, 1 August 1960.
NASA PLANS THREE-MAN SPACECRAFT.

9. AVIATION WEEK. 73:26-27, 29 August 1960.
APOLLO CONCURRED AS FLEXIBLE SPACECRAFT. E. H. Kolcum.

10. AVIATION WEEK. 74:32-33, 7 January 1961.
APOLLO WILL AVOID SOLAR RADIATION HAZARDS. E. H. Kolcum.

Radiation shielding for the Apollo spacecraft can be built with existing knowledge.

11. AVIATION WEEK. 74:22-23, 20 March 1961.
APOLLO, LARGE BOOSTER ACCELERATION DUE. E. H. Kolcum.

12. AVIATION WEEK. 74:38, 17 April 1961.
PROJECT APOLLO FLIGHT ADVANCED ONE YEAR.

Redirection of Project Apollo to advance the launching to 1965 one year earlier than planned was announced by NASA.

13. AVIATION WEEK. 74:32, 24 April 1961.
FIRST PHOTOS OF GE'S APOLLO CONFIGURATION.

14. AVIATION WEEK. 74:24, 22 May 1961.
APOLLO CONTRACT DUE IN JANUARY IF BUDGET INCREASE IS APPROVED.

15. AVIATION WEEK. 74:26, 24 May 1961.
INCREASED APOLLO APPROPRIATIONS TO ACCELERATE DESIGN HARDWARE.

16. AVIATION WEEK. 74:26, 14 June 1961.
SATURN C-3 APPROVED TO LAUNCH APOLLO B.

17. AVIATION WEEK. 75:29-30, 31 July 1961.
APOLLO DESIGNS USE NOSE CONE CONCEPTS.

18. AVIATION WEEK. 75:31, 21 August 1961.
APOLLO LUNAR ENGINE TO HANDLE FIVE JOBS.

The lunar propulsion module will be required to perform the following tasks: trans-lunar midcourse velocity control, lunar orbit injection, lunar orbit retro-fire, lowering descent to lunar surface and lunar lift-off and return to earth.

19. AVIATION WEEK. 75:26-28, 4 December 1961.
NORTH AMERICAN TO BUILD APOLLO SPACECRAFT. E. Clark.

20. FLIGHT. 78:867-869, 2 December 1960.
MERCURY--AND AFTER. Kenneth Owen.

Traces the development of the Apollo Project.

21. FLIGHT. 80:227-229, 17 August 1961.
AMERICA AIMS AT THE MOON.

A review of various lunar programs of the United States.

22. MISSILES AND ROCKETS. 7:42-43, 22 February 1960.
ASTRONAUTS WILL EARN THEIR WAY.

23. MISSILES AND ROCKETS. 7:20-21, 8 August 1960.
APOLLO 3-MAN CRAFT TO FOLLOW MERCURY.

24. MISSILES AND ROCKETS. 7:13, 5 September 1960.
ADMINISTRATION ACTS TO SPEED APOLLO. Jay Holmes.

25. MISSILES AND ROCKETS. 7:16, 24 October 1960.
COMMITTEE TO WATCH FOR AIR FORCE DUPLICATION OF APOLLO.

26. MISSILES AND ROCKETS. 8:19, 2 January 1961.
HOW TO MAKE MAN EFFICIENT IN SPACE. H. M. David.

27. MISSILES AND ROCKETS. 8:24, 13 March 1961.
NASA MAPS PAST MERCURY MANNED SHOTS.

28. MISSILES AND ROCKETS. 8:16, 17 April 1961.
NASA MAY CUT CHIMP TRIP IN MERCURY ATLAS PLANS.

Requests for additional money for Project Apollo.

29. MISSILES AND ROCKETS. 8:33-35, 29 May 1961.
MAN IN SPACE. James Baar.

An exploration of the needs, values, and reasons for putting a man in space with special reference to Dyna-Soar, Apollo Concept, and Aerospace Plane Concept.

30. MISSILES AND ROCKETS. 8:42-43, 106-109, 113, 29 May 1961.
DUPLICATION SEEN...SPACECRAFT PLANS ARE STILL CLOUDY.

Discussion of Dyna-Soar, Apollo and Aerospace Plane.

31. MISSILES AND ROCKETS. 8:12-14, 44, 5 June 1961.
NEW BUDGET REVISION COULD LEAD MILITARY MAN-IN-SPACE.
James Baar.

32. MISSILES AND ROCKETS. 9:13, 24 July 1961.
NASA ADDS TO WEIGHT OF APOLLO LUNAR SPACECRAFT.

33. MISSILES AND ROCKETS. 9:13, 7 August 1961.
COMPETETION STARTS FOR BUILDING 50-75 TON APOLLO SPACECRAFT.

34. MISSILES AND ROCKETS. 9:37, 14 August 1961.
IN APOLLO STEP-UP...PROSPECTOR GETTING HARD SECOND LOOK.
Hal Taylor.

35. MISSILES AND ROCKETS. 9:18-19, 68, 18 September 1961.
APOLLO: GIANT EQUIPMENT, PROBLEMS.

Examination of the parameters in transportation assembly and checkout for Apollo equipment.

36. MISSILES AND ROCKETS. 9:17, 16 October 1961.
WEEK-LONG ORBIT BY '63...NEW PROGRAM MAY FILL PRE-APOLLO GAP. Hal Taylor.

37. MISSILES AND ROCKETS. 9:43, 16 October 1961.
SHEPARD ON APOLLO: MANNED CONTROL CALLED ESSENTIAL TO SUCCESS.

38. MISSILES AND ROCKETS. 9:15, 20 November 1961.
NASA TO ORDER AT LEAST TEN APOLLOS. Hal Taylor.

D. Brainerd Holmes as director of NASA's Office of Manned Space Flight - the headquarters for Apollo management agency states that at least 10 Apollo spacecraft will be ordered under the prime systems contract for the manned lunar vehicle.

39. MISSILES AND ROCKETS. 9:39-144, 27 November 1961.
M/R'S FIRST ANNUAL NASA ISSUE.

40. MISSILES AND ROCKETS. 9:15, 38, 4 December 1961.
NASA, NAA MAKING APOLLO PLANS.

Announcement of NAA's award of the Apollo Contract.

41. MISSILES AND ROCKETS. 9:50, 4 December 1961.
INSIDE STORY OF APOLLO. William J. Coughlin.

42. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.
NASA - INDUSTRY PROGRAM PLANS CONFERENCE, JULY 28-29, 1960.
Washington, D. C.: 123 pages.

MANNED SPACE FLIGHT. George M. Lous: 79-81.

Project Apollo is first described to industry.

43. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TMX-602.
STATIC LONGITUDINAL AERODYNAMICS CHARACTERISTICS OF A MODEL OF A TWO STAGE VERSION OF A SATURN LAUNCH VEHICLE WITH A PROPOSED APOLLO PAYLOAD AT MACH NUMBERS FROM 1.57 TO 2.87. J. R. Morgan and R. H. Fournier.
Washington, D. C.: September 1961, 22 pages.
AD-325 373 Confidential Report

44. ORDNANCE. 45:558, January-February 1961.
PROJECT APOLLO STUDIED.

45. PRODUCT ENGINEERING. 32:12, 24 April 1961.
NASA ACCELERATES PROJECT APOLLO FOR 1965 ORBIT.

46. SPACE AGE NEWS. 3:6, 19 June 1961.
LIFT DESIGNED INTO APOLLO'S CAPSULE.

47. SPACE AGE NEWS. 3:48, 10 July 1961.
APOLLO GAINS PACE BEFORE MERCURY COMPLETES ORBIT.

48. SPACE BUSINESS DAILY. 4(14):1, 22 July 1960.
NASA PROGRAM BRIEFING CONFERENCE.

49. SPACE BUSINESS DAILY. 4(20):11, 1 August 1960.
MORE ON APOLLO--SECOND ASTRONATION VEHICLE.

50. SPACE BUSINESS DAILY. 4(26):2, 9 August 1960.
LIFE SCIENCES STUDY FOR MANNED SPACE FLIGHT.

Garrett Corporation AiResearch Manufacturing Company work on information chart for manned space flight.

51. SPACE BUSINESS DAILY. 4(33):2, 18 August 1960.
NASA'S SPACECRAFT.

52. SPACE BUSINESS DAILY. 4(39):2, 26 August 1960.
NASA'S SPACECRAFT - PART II.

53. SPACE BUSINESS DAILY. 4(42):2-4, 31 August 1960.
PROJECT APOLLO ASTRONATION PROGRAM.

Presents in outline form Apollo's missions, requirements, objectives, and schedules.

54. SPACE BUSINESS DAILY. 4(43):2-3, 1 September 1960.
NASA'S GODDARD INDUSTRY CONFERENCE.

55. SPACE BUSINESS DAILY. 4(46):1, 7 September 1960.
APOLLO INVITATIONS.

56. SPACE BUSINESS DAILY. 4(52):1, 15 September 1960.
CONTRACTORS BRIEFED ON APOLLO.

57. SPACE BUSINESS DAILY. 4(81):1, 26 October 1960.
APOLLO FEASIBILITY STUDIES AWARDED.

NASA has awarded: Convair, Astronautics Division of General Dynamics Corporation, $250,000.00; General Electric Missile and Space Vehicle Department, $250,000.00; Martin Company, $250,000.00. Six months feasibility studies objectives (1) to define an astronation system meeting the mission requirements. Definition will include preliminary performance, systems requirements, and reliability goals to the extent possible; (2) to result in a proposed program plans for implementation relating the time, costs, and facility required for design, development, fabrication, qualification creliability, testing, and a flight test program; (3) identify technical areas that might demand long time lead for research and development; (4) assess costs of the program and to allocate them over the life-time of the project.

58. SPACE BUSINESS DAILY. 4(96):2, 17 November 1960.
AVCO JOINS CONVAIR ON APOLLO STUDY.

59. SPACE BUSINESS DAILY. 5(1):1, 4 January 1961.
APOLLO ORBITS ARE PLANNED FOR THE PERIOD 1968-1970.

There is no change in the original schedule to place a man on the moon after 1970.

60. SPACE BUSINESS DAILY. 5(18):3, 27 January 1961.

Discusses the Environmental Space Chamber to simulate radiant energy conditions encountered by satellites and spacecraft which is being built by Grumman Aircraft Engineering Corporation, New York. The company is conducting studies which will lead to proposals for Apollo to NASA.

61. SPACE BUSINESS DAILY. 5(37):3, 24 February 1961.

Apollo as conceived by Convair Astronautics would be a follow-on manned space vehicle together with a permanent space base.

62. SPACE BUSINESS DAILY. 5(60):2, 29 March 1961.
THIRTY FIRMS JOIN WITH MARTIN FOR APOLLO.

The Martin Company, one of three companies which hold a study contract from Apollo to develop designs for Apollo, has accepted the service of 30 companies to aid in the study.

63. SPACE BUSINESS DAILY. 5(69):1, 11 April 1961.
APOLLO WILL BE ADVANCED.

The attainment of Apollo capability will be advanced one year by transfer of knowledge gained in the Mercury program.

64. SPACE BUSINESS DAILY. 5(73):55-56, 17 April 1961.
APOLLO NEEDS MONEY.

R. C. Seamans, Associate Director of NASA believes that if Apollo were adequately backed the first American on the moon could be advanced to 1967.

65. SPACE BUSINESS DAILY. 5(77):73-74, 21 April 1961.
MAN ON THE MOON IN '65 WITH SOLIDS.

Dr. Cledo Brunetti, President of the Grand Central Rocket Company declared that by using solid propellant boosters a man could be put on the moon by 1965; this would cost an additional $50 million.

66. SPACE BUSINESS DAILY. 5(82):101, 28 April 1961.
THE NASA MOON PRICE TAG.

67. SPACE BUSINESS DAILY. 5(94):163, 16 May 1961.
MARTIN - RADIATION SHIELDING.

Martin Company believes that minor spot shielding of a spacecraft will be all that is necessary to protect the astronauts from radiation. The work was accomplished as a part of the six month feasibility study of Apollo for NASA.

68. SPACE BUSINESS DAILY. 5(96):172-173, 18 May 1961.
APOLLO FOLLOW-ON STUDY CONTRACT.

Marshall Space Flight Center awarded a contract of $75,000.00 to Martin Company to investigate methods of manned flight to the moon.

69. SPACE BUSINESS DAILY. 5(125):321, 29 June 1961.
NASA - INDUSTRY APOLLO TECHNICAL CONFERENCE.

Announcement of a conference sponsored by NASA - Industry on Apollo, its mission profile, navigation, guidance, and control, etc., in July 1961.

70. SPACE BUSINESS DAILY. 6(14):67, 24 July 1961.
APOLLO PLANS STILL VAGUE.

Project Apollo conference held in July had 400 firms which attended it.

71. SPACE BUSINESS DAILY. 6(17):88, 28 July 1961.
COMPLETE PROTECTION FOR ASTRONAUT NOT NECESSARY.

The Martin Company indicates that complete protection for man against space environment such as weightlessness, radiation, solar flares, etc., since man will be able to adapt to the environment.

72. SPACE BUSINESS DAILY. 6(18):93, 31 July 1961.
TWELVE SELECTED TO BID FOR APOLLO.

73. SPACE BUSINESS DAILY. 6(27):136, 11 August 1961.
MIT SELECTED FOR APOLLO GUIDANCE.

NASA announced intentions to negotiate with MIT's Instrument Laboratory for a $4 million contract to design and develop the guidance navigation system for Apollo.

74. SPACE BUSINESS DAILY. 6(35):179, 23 August 1961.
APOLLO SITE SURVEY TEAM.

NASA's four man team is studying the location of a site for the $4 million space flight center for Apollo.

75. SPACE BUSINESS DAILY. 6(37):190, 25 August 1961.
APOLLO CENTER MEETING.

76. SPACE BUSINESS DAILY. 6(44):222, 6 September 1961.
APOLLO HEADQUARTERS.

New site could possibly be Massachusetts.

77. SPACE BUSINESS DAILY. 6(49):249, 13 September 1961.
NEW ENGLAND WANTS APOLLO LABORATORY.

78. SPACE BUSINESS DAILY. 6(56):289, 25 September 1961.
THIOKOL PART OF APOLLO TEAM.

Thiokol has been selected as the propulsion partner of the General Electric - Douglas team for bidding on the prime contract for Apollo.

79. SPACE BUSINESS DAILY. 6(65):343-344, 6 October 1961.
WILL WEIGHTLESSNESS AFFECT APOLLO?

80. SPACE BUSINESS DAILY. 6(66):35, 9 October 1961.
WEIGHTLESSNESS AT CROSSROAD.

We must prove or disprove the effect of weightlessness on the astronaut.

81. SPACE BUSINESS DAILY. 6(71):383, 16 October 1961.
THIOKOL AND APOLLO.

Thiokol's Reaction Motors Division is working on a flight vortex injector chambers of the type proposed for the Apollo vernier propulsion engine.

82. SPACE BUSINESS DAILY. 6(86):469, 6 November 1961.
APOLLO EVALUATION ENTERS SECOND PHASE.

83. SPACE BUSINESS DAILY. 6(102):565, 29 November 1961.
NORTH AMERICAN SELECTED FOR APOLLO.

North American Aviation listed as "dark horse".

84. SPACE FLIGHT. 3:19-22, January 1961.
THE SATURN FAMILY.

Gives a summary of Dr. Von Braun's description of the Saturn C-1 and C-2 boosters and the application to Project Apollo.

85. SPACE TECHNOLOGY. 3:38-39, October 1960.
APOLLO CONCEIVED AS FLEXIBLE SPACECRAFT. E. H. Kolcum.

86. SPACE TECHNOLOGY. 4:43-44, April 1961.
APOLLO, LARGE BOOSTER ACCELERATION DUE. E. H. Kolcum.

87. SPACE TECHNOLOGY. 4:32-35, July 1961.
SPACE PROGRAM WILL COST $25 - $30 BILLION OVER FIVE YEARS.
E. H. Kolcum.

88. SPACE TECHNOLOGY. 4:41-42, October 1961.
APOLLO DESIGNS USE NOSE CONE CONCEPTS.

89. SPACE TECHNOLOGY. 4:43, October 1961.
TWO-STAGE APOLLO LAUNCH VEHICLE PROPOSED.

90. SYLVANIA ELECTRONIC PRODUCTS, INC.:50, 12 October 1961.
PROPOSAL FOR MISSION SIMULATOR COMPUTORS.

PART II - ORBITAL RENDEZVOUS

91. ADVANCES IN THE ASTRONAUTICAL SCIENCES. 5:218-236, 1959.
New York, American Astronautical Society, 1960.
THE INFLUENCE OF LAUNCH CONDITIONS ON THE FRIENDLY RENDEZVOUS OF ASTRO-VEHICLES. R. S. Swanson and N. V. Petersen.

Presents a method of determining "rendezvous - compatable orbits" with emphasis on the special rendezvous which allows two rendezvous per Earth's rotation from a single launch base.

92. ADVANCES IN THE ASTRONAUTICAL SCIENCES. 6:147-160, 1960.
New York, American Astronautical Society, 1961.
AN ASTRO-VEHICLE RENDEZVOUS GUIDANCE CONCEPT.
R. S. Swanson, et al.

System which uses a control-computer system for rendezvous operations is presented which is tolerant of launch guidance errors.

93. ADVANCES IN THE ASTRONAUTICAL SCIENCES. 6:192-228, 1960.
New York, American Astronautical Society, 1961.
PATH CONTROL FOR SATELLITE RENDEZVOUS. R. E. Roberson.

Considers the nature of ascent paths with reference to existing literature and presents the functional nature which is implied by the necessary maneuvers.

94. AEROPLANE.:838, 23 December 1960.
SPACE RENDEZVOUS BY 1964?

95. AEROPLANE.:299, 17 March 1961.
LINKING SATELLITES IN ORBIT.

96. AEROSPACE ENGINEERING. 19:70-71, May 1960.
ORBITAL RENDEZVOUS AND GUIDANCE. E. A. Steinhoff.

97. AEROSPACE ENGINEERING. 19:72-73, May 1960.
RENDEZVOUS IN SPACE; EFFECTS OF LAUNCH CONDITIONS.
N. V. Petersen.

98. AEROSPACE ENGINEERING. 19:74-75, May 1960.
ASCENT GUIDANCE FOR A SATELLITE RENDEZVOUS. T. B. Garber.

99. AEROSPACE ENGINEERING. 19:76-77, May 1960.

A GUIDANCE TECHNIQUE FOR ACHIEVING RENDEZVOUS.
P. G. Felleman.

100. AEROSPACE ENGINEERING. 19:78-79, May 1960.
MANNED CONTROL OF ORBITAL RENDEZVOUS. E. Levine.

101. AEROSPACE ENGINEERING. 19:32-36, June 1960.
THE LONG-TIME SATELLITE RENDEZVOUS TRAJECTORY.
L. W. Spradlin.

Formulation of plans to launch a vehicle into orbit to rendezvous with a satellite.

102. AEROSPACE ENGINEERING. 20:20-21, 84-91, March 1961.
PILOT CONTROL OF RENDEZVOUS. M. C. Kurbjun and
R. F. Brissenden.

This study uses a pilot in a closed simulation loop, including a fixed base cockpit simulator having the required instruments and an analog computer.

103. AIR FORCE. 44:40-44, December 1961.
RENDEZVOUS: KEY TO SPACE. J. S. Butz, Jr.

The controversy over a giant Nova verses the rendezvous technique has been settled by Officials of NASA. The basic conclusions are these: 1. rendezvous vehicles can be economically launched; 2. mid-coarse and terminal approach guidance will be needed; 3. docking or the final joining of two vehicles in space must also be considered.

104. AMERICAN ASTRONAUTICAL SOCIETY. PREPRINT 59-16.
THE INFLUENCE OF LAUNCH CONDITIONS ON THE FRIENDLY RENDEZVOUS OF ASTRO-VEHICLES. R. S. Swanson and N. V. Petersen. August 1959.

105. AMERICAN ROCKET SOCIETY.
GUIDANCE, CONTROL, AND NAVIGATION CONFERENCE.
Palo Alto, California: Stanford University. August 1961.

Papers of interest are:
1912 A terminal guidance system for soft lunar landing.
1952 A terminal guidance scheme for docking satellites.
1953 Orbital docking dynamics.
1954 Station keeping of satellites in rendezvous compatible orbits.

106. AMERICAN ROCKET SOCIETY JOURNAL. 30:41-46, January 1960.
MIDCOURSE GUIDANCE PROBLEMS IN SATELLITE INTERCEPTION.
A. J. Skalafuris.

107. AMERICAN ROCKET SOCIETY JOURNAL. 30:54-60, January 1960.
USE OF ENERGY STORAGE IN LOW THRUST SPACEFLIGHT.
M. Camac.

Among other topics which are discussed is the rendezvous maneuvors between satellite orbits at low altitudes.

108. AMERICAN ROCKET SOCIETY JOURNAL. 30:734-739, August 1960.
CONTINUOUSLY POWERED TERMINAL MANEUVER FOR SATELLITE RENDEZVOUS. N. E. Sears, Jr. and P. G. Felleman.

109. AMERICAN ROCKET SOCIETY JOURNAL. 30:902-903, September 1960.
TERMINAL GUIDANCE TECHNIQUE FOR SATELLITE INTERCEPTION - UTILIZING CONSTANT THRUST ROCKET MOTOR.

Terminal guidance law is formulated for collision course and for achievement of satellite rendezvous using constant thrust rocket motors.

110. AMERICAN ROCKET SOCIETY JOURNAL. 30:1089-1091, November 1960.
OPTIMUM TIME TO RENDEZVOUS. J. M. Eggleston.

Gives a method for the calculation of the optimum time to rendezvous. The optimum time is defined as that value of time requiring the smallest velocity correction.

111. AMERICAN ROCKET SOCIETY JOURNAL. 31:505-513, April 1961.
ERROR ANALYSIS CONSIDERATIONS FOR A SATELLITE RENDEZVOUS.
W. M. Duke, et al.

A system for satellite rendezvous with a target is given. The terminal maneuver uses a self-contained radar to track the target.

112. AMERICAN ROCKET SOCIETY JOURNAL. 31:1096-1102, August 1961.
CONTROLLED RENDEZVOUS OF ORBITING SPACE STATIONS.
Normal S. Potter.

Investigations of the performance and optimization of satellite some terminal acquisition and associated guidance system for the rendezvous of orbiting space stations.

113. AMERICAN ROCKET SOCIETY JOURNAL. 31:1516-1521, November 1961.
SATELLITE RENDEZVOUS TERMINAL GUIDANCE SYSTEM.
K. F. Steffan.

This system concept is suitable for space rendezvous, such as interrogation and possible negation of enemy satellites, etc. The outstanding aspect is the intermittent instrumentation of the intercepter trajectory corrections.

114. AMERICAN ROCKET SOCIETY. Paper 778-59.
TERMINAL GUIDANCE FOR A SATELLITE RENDEZVOUS. N. E. Sears, and P. G. Felleman. New York, New York: 1959.

Presented at the American Rocket Society controllable satellites conference at Massachusettes Institute of Technology 30 April- 1 May 1959.

115. AMERICAN ROCKET SOCIETY. Paper 1176-60.
AN INVESTIGATION OF A TERMINAL GUIDANCE SYSTEM FOR A SATELLITE RENDEZVOUS. N. J. Niemi. New York, New York: 9-12 May 1960, 32 pages.

Guidance scheme for a soft rendezvous between earth and a space vehicle is presented. The scheme is based on satellite-vehicle radial separation, radial velocity, and note of rotation around the vehicle.

116. AMERICAN ROCKET SOCIETY. Paper 61-206-1900.
TERMINAL MANEUVERS FOR SATELLITE ASCENT RENDEZVOUS. P. W. Soule and A. T. Kidd. New York, New York, 13-16 June 1961.

In this paper two vehicles in a rendezvous situation are close to each other but have high velocities. The terminal phase is analyzed to determine the optimum aiming point for the transfer trajectory.

117. ARMY SIGNAL MISSILE SUPPORT AGENCY. MISSILE ELECTRONICS WARFARE DIVISION. 1103.
MOTION OF ARTIFICIAL SATELLITES: A BIBLIOGRAPHY OF PERIODICAL LITERATURE. James S. Bethel. White Sands Missile Range, New Mexico, 30 October 1961, 25 pages.

Cited in this bibliography are 258 articles related to various aspects of artificial satellite mechanics. All the articles were either written in English or translated into the language from Russian; they appear in technical journals during the period 1946 to 1961.

118. ASTRONAUTICA ACTA. 5(5):253-265, 1959.
THE CALCULATION OF MINIMAL ORBITS. G. C. Smith.

Equations for determining the method of transfer of a rocket between two coplanar orbits with minimum fuel expenditure are presented.

119. ASTRONAUTICA ACTA. 5(6):328-346, 1959.
ON MID-COURSE GUIDANCE IN SATELLITE INTERCEPTION.
G. W. Morgenthaler.

Irregardless of purpose there will be a need for the transfer of men or material from satellite to space vehicles and the computations on mid-course guidance on satellite interception is explored here mathematically.

120. ASTRONAUTICA ACTA. 7(2-3):92-102, 1961.
STATUS REPORT ON THE SATURN SPACE CARRIER VEHICLE AND ITS POTENTIAL APPLICATIONS. Wernher Von Braun.

In the concluding remarks Von Braun notes that from the outset the long range objectives of the NASA space program has been the manned exploration of the moon and the planets of our Solar System. Eventually more powerful vehicles than Saturn will be needed but in the meantime Saturn offers a reliable work-horse for the critical years ahead.

121. ASTRONAUTICAL SCIENCES REVIEW. 1:11-12, 21, October-December 1959.
PROPULSION SYSTEM FOR RENDEZVOUS IN SPACE. C. J. Kaplan and D. P. Buergin.

Large manned satellites may be launched in a number of separate sections which can be assembled in orbit

122. ASTRONAUTICAL SCIENCES REVIEW. 1:13-14, 20, October - December 1959.
RENDEZVOUS - COMPATIBLE ORBITS. N. V. Petersen and R. S. Swanson.

Problems associated with determination of compatible orbits with emphasis on those orbits which permit two rendezvous per earth's motion.

123. ASTRONAUTICAL SCIENCES REVIEW. 1:15-16, 21, October-December 1959.
ORBITAL RENDEZVOUS SIMULATOR. E. Levin and J. Ward.

Orbital rendezvous operations are separated into distinct phases, launch, closing, and docking devices. The simulator was assembled at the Rand Corporation for study.

124. ASTRONAUTICS. 5:66, January 1960.
SPACE FERRY PROPOSED BY HUGHES-LOCKHEED.

125. ASTRONAUTICS. 6:20-22, 46-47, 50-52, April 1961.
RENDEZVOUS IN SPACE. K. R. Stehling.

The technical aspects of rendezvous projects are weighed against the increasing size of the boosters and the limitations imposed on the size of booster rockets.

126. ASTRONAUTICS. 6:32-33, 44-46, June 1961.
SATRAC - SPACE RENDEZVOUS SYSTEM. L. J. Kamm.

This article presents the design features for Satellite Automatic Terminal Rendezvous and Coupling (SATRAC) optical homing guidance system and a coupling mechanism to join cooperative satellite.

127. AVIATION WEEK. 74:30, 29 May 1961.
PERFECTION OF ORBITAL RENDEZVOUS ADVANCES SAINT TIMETABLE.

128. AVIATION WEEK. 75:26-27, 6 November 1961.
RENDEZVOUS IS URGED FOR MOON FLIGHT. E. H. Kolcum.

The Golovin Committee which studied the rendezvous technique and recommends it to the NASA and the Defence Department. This is referred to as OLO (Orbital Launch Operations).

129. AVIATION WEEK. 75:32-33, 20 November 1961.
NASA STUDIES WIDER RENDEZVOUS CONCEPT. George Alexander.

NASA is studying the concept called OLO (Orbital Launch Operations) which would make maximum use of the rendezvous technique for multiple operational and support missions including Apollo.

130. INSTITUTE OF RADIO ENGINEERS TRANSACTIONS ON AERONAUTICAL AND NAVIGATIONAL ELECTRONICS. ANE-7:110-118, December 1960.
CONDITIONAL SWITCHING TERMINAL GUIDANCE. A. L. Passera.

131. INSTITUTE OF THE AEROSPACE SCIENCES. Paper 59-93.
TERMINAL GUIDANCE SYSTEM FOR SATELLITE RENDEZVOUS.
W. H. Clohessy and R. S. Wiltshire. New York, New York: June 1959.

132. INSTITUTE OF THE AEROSPACE SCIENCES. Paper 61-5.
CHANGE OF SATELLITE ORBIT PLANE BY AERODYNAMIC MANEUVERING.
H. S. London. New York, New York:23-25, January 1961.

Maneuvers are modified by the aerodynamic forces during one or more skips into or out of atmosphere.

133. INSTITUTE OF THE AEROSPACE SCIENCES. Paper 61-10.
PRELIMINARY COMPARISON OF AIR AND GROUND LAUNCHING OF SATELLITE RENDEZVOUS VEHICLES. T. N. Edelbaum. New York, New York:23-25, January 1961, 22 pages.

Comparison of the use of air and ground launching of satellite rendezvous vehicles into arbitrary orbit planes. For both cases the amount of payload that can be launched is compared with the amount that can be launched into an orbit that passes directly over the launch point.

134. INTERNATIONAL ASTRONAUTICAL CONGRESS, PROCEEDINGS OF THE IXTH, 1958.
Wien: Springer-Verlag, 1959.
ON THE DEVELOPMENT OF ORBITAL TECHNIQUES, A CLASSIFICATION OF ORBITAL CARRIERS AND SATELLITE VEHICLES. H. H. Koelle.
Pages 702-746.

Presents a classification of orbital carriers, satellite vehicles and re-entry vehicles classed by their control requirements and maneuverability. About 860 bibliographical citations are given as a cross reference of the type of literature which is available.

135. JOURNAL OF THE AERO/SPACE SCIENCES. 27:653-658, 674, 9 September 1960.
TERMINAL GUIDANCE SYSTEM FOR SATELLITE RENDEZVOUS.
W. H. Clohessy and R. S. Wiltshire.

Also: ASTRONAUTICAL SCIENCES REVIEW. 1:9-10, October-December 1959.

Review of satellite rendezvous terminal guidance requirements, command guidance systems, etc.

136. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Masters Thesis.
AN ANALYSIS OF A MANNED LUNAR SYSTEM. Nathaniel Harrison Keezell, Jr., Cambridge: June 1961, 37 pages.

Technical problems associated with landing man on the moon and returning them to earth are examined. The methods of analysis are applicable to space missions in general, not only to lunar missions. It is a basic assumption in this report that no computer solutions will be used; therefore, simplified two-body methods of analyzing trajectories and approximate solutions for heating problems will be used.

137. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. R-331.
SATELLITE - RENDEZVOUS GUIDANCE SYSTEM. N. E. Sears.
Cambridge, Massachusetts: May 1961, 290 pages.
AD-324 421 Secret report.

138. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. R-232.
TERMINAL GUIDANCE FOR A SATELLITE RENDEZVOUS. N. E. Sears and P. G. Felleman. Cambridge, Massachusetts: April 1959.

139. MAXON, W. L., CORPORATION. ARS 1483-60.
THE CONTROLLED RENDEZVOUS OF ORBITING SPACE STATIONS. Norman S. Potter. New York:1960, 12 pages.
AD-255 046

The performance and optimization of satellite borne terminal acquisition and associated external gross guidance systems for effecting the rendezvous of orbiting space stations is investigated. Subject to very weak constraints a broadly applicable analysis of the influence of the relative trajectories and the error in the information output of the vectoring and control environment is developed, and the integration of the composite system discussed.

140. MISSILES AND ROCKETS. 8:28, 30-32, 3 April 1961.
DESIGNING DATA DISPLAY FOR PILOT OF SPACECRAFT.
C. O. Hopkins and D. K. Bauerschmidt.

An analysis of the data display which is needed by an astronaut of a spacecraft including the system requirements and system functions needed for orbital rendezvous.

141. MISSILES AND ROCKETS. 8:24, 29 May 1961.
ORBITAL WORK CAN AID MOON LANDING.

Orbital rendezvous could step up the Project Apollo.

142. MISSILES AND ROCKETS. 8:62, 29 May 1961.
GUIDANCE/CONTROL KNOWHOW IS AMPLE. C. D. LaFond.

143. MISSILES AND ROCKETS. 9:18, 42, 13 November 1961.
IN FISCAL YEAR 1963, RENDEZVOUS MAY COST $160 MILLION.
William Beller.

A discussion of NASA's orbital rendezvous costs.

144. MISSIIES AND ROCKETS. 9:14, 4 December 1961. RENDEZVOUS CHECK, GOLOVIN GROUP ORDERED TO RE-EXAMINE CONCEPTS.

145. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-81. METHODS AND VELOCITY REQUIREMENTS FOR THE RENDEZVOUS OF SATELLITES IN CIRCUMPLANETARY ORBITS. W. E. Brunk and R. J. Flaherty. Washington, D. C.: October 1959.

146. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-437. A TWO IMPULSE PLAN FOR PERFORMING RENDEZVOUS ON A ONCE-A-DAY BASIS. J. D. Bird and D. F. Thomas. Washington, D. C.: November 1960, 36 pages.

Studies a two-impulse plan for performing rendezvous on a once-a-day basis with a near-Earth satellite station indicates that launch from less than maximum satellite altitude is a favorable circumstance in that no appreciable expense in mass ratio is incurred.

147. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-511. SIMULATOR INVESTIGATION OF CONTROLS AND DISPLAY REQUIRED FOR TERMINAL PHASE OF COPLANAR ORBITAL RENDEZVOUS. C. H. Wolovicz, et al. Washington, D. C.: October 1960, 30 pages.

By using two oscilloscopes, one direct vision presentation, and three control modes, the terminal phase of coplanar orbital rendezvous methods were studied. The vehicle was considered as being in orbit 500 miles above earth.

148. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-747. ANALOG SIMULATION OF A PILOT-CONTROLLED RENDEZVOUS. R. F. Brissenden, et al. Washington, D. C.:1961, 51 pages.

149. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-772. TRAJECTORY CONTROL IN RENDEZVOUS PROBLEMS USING PROPORTIONAL NAVIGATION. L. S. Cicolani. Washington, D. C.: April 1961, 44 pages.

Defines the rendezvous problem then states that the proportional navigation theory allows the interception of a target by the vehicle. Finally he applies the theory to the satellite rendezvous problems and presents some computation.

150. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-883. ANALYTICAL EVALUATION OF A METHOD OF MID-COURSE, GUIDANCE FOR RENDEZVOUS WITH EARTH SATELLITES. J. M. Eggleston and R. S. Dunning. Washington, D. C.: June 1961, 61 pages.

Simulation by electronic computer was made of the ascent phase of a rendezvous between a ferry and a space station. The results are used to study the effectiveness of the guidance equations and the effects of errors in launch conditions.

151. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-923. AN AUTOMATIC TERMINAL GUIDANCE SYSTEM FOR RENDEZVOUS WITH A SATELLITE. Terrance M. Carney. Washington, D. C.: August 1961, 68 pages.
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A steering and control system for automatic terminal guidance in direct-ascent satellite rendezvous, using control of thrust magnitude and direction, is presented and analyzed.

152. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-953. ANALYSIS OF A LINEAR SYSTEM FOR VARIABLE-THRUST CONTROL IN THE TERMINAL PHASE OF RENDEZVOUS. R. A. Hord and B. J. Durling. Washington, D. C.: September 1961, 43 pages.

This paper considers the thrust control system which requires that the ferry thrust per unit mass be variable and equal to suitable linear combination of the position which are relative to the satellite.

153. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. TN D-965. ANALYTICAL AND PRELIMINARY SIMULATION STUDY OF A PILOTS ABILITY TO CONTROL THE TERMINAL PHASE OF A RENDEZVOUS WITH SIMPLE OPTICAL CLINICS AND A TIMER. E. C. Lineberry, et al. Washington, D. C.: October 1961.

154. NATIONAL AEROSPACE ELECTRONICS CONFERENCE, PROCEEDINGS. New York: Institute of Radio Engineers. May 1961. GUIDANCE/CONTROL SYSTEM INTEGRATION IN SATELLITE RENDEZVOUS. N. S. Potter.

155. NATIONAL SPECIALISTS MEETING ON GUIDANCE OF AEROSPACE VEHICLES, PROCEEDINGS, 1960. New York: Institute of the Aerospace Sciences. May 1960. THE LONG-TIME SATELLITE RENDEZVOUS TRAJECTORY. Lewis W. Spradlin, pages 21-27.

156. NATIONAL SPECIALISTS MEETING ON GUIDANCE OF AEROSPACE VEHICLES, PROCEEDINGS, 1960. New York: Institute of the Aerospace Sciences. May 1960. SOME CONSIDERATIONS OF GUIDANCE AND CONTROL TECHNIQUES FOR COPLANAR ORBITAL RENDEZVOUS. Eugene Harrison, pages 14-20.

157. NAVIGATION. 6:445-459, Autumn 1959. SATELLITE RENDEZVOUS NAVIGATIONAL REQUIREMENTS. N. V. Peterson, et al.

158. NORTHROP CORPORATION. NORAIR DIVISION. ASG-TM-61-10. SUMMARY REPORT OF RENDEZVOUS/COMPATIBLE ORBITS. R. S. Swanson and N. V. Petersen. Hawthorne, California: January 1961.

Emphasis is placed on those orbits which permit two rendezvous per Earth's rotation from a single launch site.

159. NORTHROP CORPORATION. NORAIR DIVISION. NB61-78. ASG-TM-61-41. TERMINAL VELOCITY AND ORBITING TIMES. G. S. Gedeon and D. A. Pierce. Hawthorne, California: June 1961.

Gives sets of tables which allow one to read various factors. The equations used to obtain the tables are based on the two-body problem.

160. NORTHROP - NORAIR NEWS.:1, 20 January 1960. A RENDEZVOUS IN ORBIT.

161. SOCIETY OF AUTOMOTIVE ENGINEERS, INC. Paper 175A. CONSIDERATIONS OF THE RENDEZVOUS PROBLEM FOR SPACE VEHICLES. J. C. Houboult.

Abstract in SOCIETY OF AUTOMOTIVE ENGINEERS JOURNAL. 68:119, July 1960.

Paper was presented to the Society of Automotive Engineers National Aeronautic Meeting, New York, New York, 5-8 April 1960. Surveys the problems involved in making a soft rendezvous in space, as in the transfer of personnel or supplies from a ferry vehicle to a space station.

162. SPACE/AERONAUTICS. 32(2):61-63, August 1959. MANNED SPACE STATION NEEDS SPECIAL 'FERRIES' AND 'TUGS'. S. B. Kramer and R. A. Byers.

163. SPACE/AERONAUTICS. 35:51-53, January 1961. GETTING TO THE MOON. I. K. R. Stehling.

Rendezvous techniques and altitude control techniques are considered and environmental system insuring the survival of the crew are noted.

164. SPACE AGE NEWS. 3:1, 13 February 1961. IN-TRANSIT RENDEZVOUS FOR SPACECRAFT STUDIED BY NASA.

165. SPACE BUSINESS DAILY. 4(110):4, 8 December 1960.
SPACE RENDEZVOUS.

The United States can use a rendezvous in space between the Apollo and a spacecraft from Earth according to the American Rocket Society.

166. SPACE BUSINESS DAILY. 6(37):187-188, 25 August 1961.
NASA TO INCREASE RENDEZVOUS CONTRACTING.

167. SPACE BUSINESS DAILY. 6(62):325-328, 3 October 1961.
ORBIT RENDEZVOUS.

Without orbit rendezvous we will not be capable of putting a man on the moon before Nova #4.

168. SPACE BUSINESS DAILY. 6(63):331, 335, 4 October 1961.
RENDEZVOUS - A FOREGONE CONCLUSION.

169. SPACE BUSINESS DAILY. 6(68):361-362, 11 October 1961.
ORBIT RENDEZVOUS DECISION NEEDED.

170. SPACE BUSINESS DAILY. 6(70):377, 13 October 1961.
NORTHROP AND RENDEZVOUS.

By utilizing the principle of orbital rendezvous for space it could cut two years from the United States timetable.

171. SPACE BUSINESS DAILY. 6(99):546, 550, 24 November 1961.
WEBB ON ORBIT RENDEZVOUS.

172. SPACE BUSINESS DAILY. 6(100):552-553, 27 November 1961.
ORBITAL RENDEZVOUS RECONVENES GOLOVIN.

173. SPACE FLIGHT. 11:182, April 1960.
SPACE FERRY.

Lockheed and Hughes Aircraft has proposed a piloted space ferry which is designed to shuttle man and equipment between the Earth and an orbited space station.

174. SPACE TECHNOLOGY. 4:19, July 1961.
PERFECTION OF ORBITAL RENDEZVOUS ADVANCES PROJECT SAINT TIMETABLE.

175. SPACE WORLD. 1:37, 27 January 1961.
SPACE REFUELING. C. E. Kaempen.

176. SPACE WORLD. 1:40-41, June 1961.
PIGGY-BACK TO VENUS.

177. VECTORS. 2(2):5-9, 1960.
FERRY TO SPACE.

Presents the technical problems of extraterrestrial flight and orbital ferries.

178. WESTERN AVIATION. 40:12-15, 31, February 1960.
AN ASTRO VEHICLE RENDEZVOUS-GUIDANCE CONCEPT.
R. S. Swanson, et al.

179. WRIGHT AIR DEVELOPMENT DIVISION. TR 60-857.
LAUNCHING AND ALIGNMENT SYSTEMS FOR AERO-SPACE VEHICLES.
N. T. Levings, Jr. Grand Rapids, Michigan: Cleveland Pneumatic Industries, Inc.: May 1961, 110 pages.
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